

## CLAIMS

1. A method of performing an inversion operation in a cryptographic calculation with at least two auxiliary variables, the method comprising shifting (S2) a variable, then effecting a reduction (S3) by subtracting that variable  
5 from a larger variable.
2. A method according to Claim 1 wherein the variables are of the same degree.
- 10 3. A method according to Claim 1 or 2 comprising updating a plurality of additional variables such that the invariances remain valid.
4. A method according to any preceding claim comprising four auxiliary variables being U, V, R and S, having the invariances:  
15  $|S.V-R.U| = N$   
 $S.Y = U \bmod N$   
 $R.Y = V \bmod N$ .
5. A method according to Claim 4 comprising decreasing U and V in  
20 size, step by step until  $U = 1$ .
6. A method according to Claim 5 comprising effecting the operation  $R.Y = 1 \bmod N$  or  $R = Y^{-1} \bmod N$ , as appropriate.
- 25 7. A method according to any preceding claim comprising operating with the Most Significant Words of the variables.
8. A method according to any preceding claim comprising providing inversion (S1-S4) over  $GF(p)$ .

9. A method according to any preceding claim comprising providing inversion (S10-S12) over  $GF(2^n)$ .

10. A method according to any preceding claim comprising providing  
5 a method for long-integer division operations.

11. A computer program product directly loadable into the internal memory of a digital computer, comprising software code portions for performing the method of any one or more of Claims 1 to 10 when said product  
10 is run on a computer.

12. A computer program directly loadable into the international memory of a digital computer, comprising software code portions for performing the method of any one of Claims 1 to 10 when said program is run  
15 on a computer.

13. A carrier, which may comprise electronic signals, for a computer program of Claim 12.

20 14. Electronic distribution of a computer program product of Claim 11 or a computer program of Claim 12 or a carrier of Claim 13.

15. Apparatus for performing an inversion operation in a cryptographic calculation with at least two auxiliary variables, the apparatus  
25 comprising means to shift a variable (V, R) and means (10-17) to effect a reduction by subtraction or addition of that variable from a larger variable.

16. Apparatus according to Claim 15 wherein the variables (V, R) are of the same degree without shifting.

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17. Apparatus according to Claim 15 or 16 comprising means to update a plurality of additional variables such that the invariance remains valid.

18. Apparatus according to any of Claims 15 to 17 comprising means (10-13) to operate four auxiliary variables being U, V, R and S, having the invariances:

5         $|S.V-R.U| = N$   
          $S.Y = U \bmod N$   
          $R.Y = V \bmod N.$

19. Apparatus according to Claim 18 comprising means (10, 11) to  
10    decrease U and V in size, step by step until  $U = 1$ .

20. Apparatus according to Claim 19 comprising means (10-16) to effect the operation  $R.Y = 1 \bmod N$  or  $R = Y^{-1} \bmod N$ , as appropriate.

15        21. Apparatus according to any of Claims 15 to 20 comprising means to operate with the Most Significant Words of the variables.

22. Apparatus for performing an inversion operation in a cryptographic calculation substantially as hereinbefore described with  
20    reference to, and/or as illustrated in, any one or more of the Figures of the accompanying drawings.

23. A method of performing an inversion operation in a cryptographic calculation substantially as hereinbefore described with reference to, and/or as  
25    illustrated in, any one or more of the Figures of the accompanying drawings.